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How do Unusual Working Schedules Affect Social Life?

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Abstract

The widening of the working hour distribution complicates the coordination of social leisure. This paper examines the short- and long-run impact of unusual working schedules on social life using German Time Use Data for 2001/02. I find evidence that younger workers with higher than median earnings seem to accept higher levels of solitary leisure as investment and because of the substantial wage premia. Younger workers tend to substitute sleep with free time. Older workers, in contrast, tend to sleep less which can be interpreted as elevated risk of mental and physical health.

Keywords: Shift Work, Non-Standard Working Hours, Time Allocation, Social Capital, Social Life, Solitary Leisure, Adverse Consequences

JEL Classification: J22, J28, J81, D62

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1 Introduction

The share of shift work in Germany rose steadily from 11 percent in the early 1990s to about 17 percent in 2008. Simultaneously, the dispersion of the working hours distribution increased not just due to the relaxation of work time regulations such as the shop opening hours but also the simultaneous expansion of employment in service activities. The importance of work during non-standard hours therefore increases and becomes more and more a fundamental pattern of the German workforce. It therefore influences the lifestyle of a large part of the population and has immediate consequences on social life in that the disconnectedness of a society's members intensifies (Burda 2000). The implied decline in the marginal utility of leisure due to a lack of potential leisure companions and the resulting deterioration of social capital are likely to entail additional negative implications for an individual's well-being. The impact is even more severe if the higher fractions of solitary leisure are not due to higher preferences for aloneness (Putnam 1995). In addition, non-standard working schedules are likely to disrupt the circadian cycle which has additional adverse effects on the worker's well-being and on physical and mental general health.[1]

The strong interest of medical and social sciences in the consequences of non-standard working schedules further underlines the perception that such working conditions are disamenities which workers try to avoid if possible.[2] Labor economists generally believe that disamenities must be compensated with higher wages to attract workers to such jobs (Smith 1776, Rosen 1987, Kostiuk 1990, Lanfranchi et al. 2002). However, the implications entailed by such working schedules on social life are important for understanding the additional threats to individual well-being but also to social capital have been largely ignored by economists so far.

The main objective of this paper is to go beyond the examination of potential wage compensations and to investigate the repercussions of such work disamenities on social life. The analysis is based on a unique dataset, the German Time Use Data, for the year 2001/02 which allows for a direct investigation of social interaction. I explore potential short- and long-run implications by investigating the influences on the fraction of solitary leisure but also on the amount of sleep. Such an analysis is economically sensible as the exposure to higher levels of solitary leisure in particular over longer time horizons might increase psychological distress which might potentially be further reflected by sleeping problems. A diminished probability of good leisure matches result-

[1] The circadian cycle represents the regular recurrence of e.g. biological activities in cycles of approximately 24 hours from one stated point to another. See for example Culpepper (2010), Minors et al. (1986).

[2] See Presser (1988, 1995), Mellor (1986), Shiells (1987), White and Keith (1990), Mayshar and Halevy (1997) for social science research and Minors et al. (1986), Cunningham (1989), Skipper et al. (1990), Costa (1996, 2003), Folkard and Tucker (2003) for medical research.

ing from non-standard working schedules decreases the marginal utility of leisure (Jenkins and Osberg 2005). This in turn adversely affects individual well-being. A reduction of individual well-being induced by the working schedules can potentially translate into adverse aggregate effects by mitigating the expected additional output from prolonged operating time.

An extensive exposure to non-standard working schedules over a longer time horizon is likely to increase the risk to mental and physical health. Work during non-standard working schedules itself disrupts the sleeping rhythm which aggravates with the length of exposure (Åkerstedt 2003). The combination of less sleep and higher levels of solitary leisure are likely to increase the risk of depression or other health related problems and hence strongly reduce well-being (West et al. 1986, Aanes et al. 2010). Such long-run risks of depressions are detectable by analyzing sleep as about 90 percent of the depressive suffer from a deprivation of sleep (Tsuno et al. 2005). Neglecting these aspects in analyses that solely focus on pecuniary incentives, largely understates social costs associated with such working schedules. The direction of the causal impact of such jobs on social relations and mental health or well-being is not entirely clear yet (Skipper et al. 1990). But an investigation of the associated influences is very instructive.

Jenkins and Osberg (2005) develop a model of companionable time use and show that time use choices are not only influenced by the person's own timing of activities or of the spouse but also by any other potential leisure companion. The authors test the consistency of their theoretical model with British data and find evidence that the probability of accompanied leisure in a certain age group depends on the probability of others who also devote time to that activity. Burda (2000) and Burda and Weil (2005), in contrast, examine efficiency gains for shop owners from the extension of shop-opening hours by means of a general equilibrium model. The authors argue that efficiency gains from longer opening hours are balanced against potential disadvantages arising from less coordinated leisure. The macroeconomic general equilibrium model allows them to derive testable implications about the impact of longer shop-opening hours on aggregate variables but they are unable to investigate the explicit consequences on solitary leisure. This paper closes this gap in the existing literature by directly examining the interrelations between working schedules and solitary leisure in a labor supply framework.

The following section presents the simple theoretical motivation which builds the foundation for the subsequent empirical analysis. This section is followed by a description of data and variables as well as of the sample properties. Apart from that, the distribution of market work across a standard workday and differences in the timing of leisure for different groups of workers are de-

scribed. Section 4 is devoted to the description and interpretation of the results for the short- and long-run consequences of unusual working schedules. Finally, section 5 concludes.

2 Theoretical Motivation

Before investigating the implications of the timing of working hours on social life and more specifically on the fraction of solitary leisure, I will present a very simple theoretical framework that builds the foundation for the subsequent empirical analysis. The following model is closely related to Jenkins and Osberg (2005).[3] Each individual maximizes his utility $U(C,L)$, by choosing the daily consumption bundle C and the amount of leisure L. I assume individual decision-making here, while the slightly more complex unitary household decision problem is given by Jenkins and Osberg (2005). Utility maximization is constraint by the available time per day as given by

$$T = L + H, \tag{1}$$

where H denotes the amount of hours worked and T is the total available time per day. The budget constraint can be formulated as:

$$C \leq wH + V, \tag{2}$$

with w denoting a vector of exogenously given wage rates and V is non-labor income. Hourly wages are allowed to vary over the day to account for wage premia paid to overtime hours or as compensation for more undesired hours.

During leisure time (L), a person can decide about the hours of leisure spent alone (A) or in the form of social leisure being enjoyed in the company of others (S). The total amount of leisure is thus the sum of time spent alone or with others: $L = A + S$. Given that working schedules are fixed, workers need to coordinate their time with others in order to socially interact. To find a suitable leisure match, people choose potential leisure companions from a ranked list. Social leisure is however uncertain ex ante because it depends on the mutual working schedules of both parties so that some leisure matches are not feasible during a particular day. The total utility derived from

[3] An alternative model is presented by Burda and Weil (2005) who use a general equilibrium model to investigate the influence of shop-opening hours on coordinated leisure and also on retail congestion.

leisure can thus be rewritten as

$$U(C,L) \quad = \quad U(C,A,S_1,\ldots,S_n), \tag{3}$$

where $S_i, i \in \{1,\ldots,n\}$ denotes social leisure time with the ith leisure companion.

I additionally assume that people can decide to work during regular hours $\left(H^R\right)$ or during unusual hours $\left(H^U\right)$. People are furthermore assumed to work a certain fraction $\omega^R = [0,1]$ of their daily working hours during the standard workday so that the number of daily working hours H can be reformulated as:

$$H \quad = \quad \omega^R H^R + \left(1-\omega^R\right) H^U. \tag{4}$$

If people spend a higher fraction of work outside the standard workday, the process to find social leisure companions is hampered as the list of potential leisure matches diminishes. Since the list of leisure companions is ranked, it is furthermore assumed that the additional utility derived from social leisure increases by rank. A leisure match is created if both leisure partners agree to enjoy time with each other. The uncertainty of a feasible leisure match will be denoted by $p_i, i \in \{1,\ldots,n\}$. The expected utility derived from this match is hence $p_i U(S_i)$ and the total expected utility for each person can be parametrized as

$$E[U(C,L)] \quad = \quad U\left(C,A,\sum_{i\in k} p_i U(S_i)\right), \tag{5}$$

with k being the available list of potential leisure companions. Following MaCurdy (1981), equation (5) can be formulated as:

$$E[U(C,L)] = \Upsilon^C (C)^{\alpha_1} - \Upsilon^A (A)^{\alpha_2} + \sum_{i\in k} p_i \Upsilon^{S_i} (S_i)^{\alpha_3+i}, \tag{6}$$

where $\alpha_j, \forall\, j \in \{1,\ldots,3+k\}$ are time invariant parameters that are common to all individuals. They have the property that $0 < \alpha_1, \alpha_{3+k} < 1$ which denotes decreasing returns and $\alpha_2 > 1$. Moreover, $\Upsilon^C, \Upsilon^A, \Upsilon^{S_i} > 0$ are functions of relevant and predetermined consumer characteristics such as age and educational level that affect preferences.

The probability to find a suitable leisure companion depends on the own available amount of free time of each person and on the working schedules of the potential leisure companions. With longer working hours or a higher fraction of work during unusual hours, the average probability

to find a suitable social leisure match declines. Hence, p_i is negatively associated with the amount of own working hours H and those of others that do not overlap with the own working hours H_{in}. The match probability can thus be expressed as:

$$\begin{aligned} p_i &= g\left(H + H_{in}\right) \\ &= g\left(\omega^R H^R + \left(1-\omega^R\right) H^U + \omega_i^R H_{in}^R + \left(1-\omega_i^R\right) H_{in}^U\right), \end{aligned} \tag{7}$$

where $g'(H) < 0$ and $g'(H_{in}) < 0$. Equation (7) suggests that a higher degree of de-synchronized working schedules, compared to standard hours, resulting from an increase in H_{in} reduces the match probability and thus, the expected utility associated with a specific leisure match. The probability converges to 0 if the schedules do not overlap at all which implies that $\omega^R = 1$ and $\omega_i^R = 0$ or vice versa. The expected marginal utility from a leisure match is lowest in this case and also a synchronization of leisure with more preferred social companions is least likely. Jenkins and Osberg (2005) show that working hours increase unambiguously if social leisure is harder to arrange but no clear predictions are possible when it comes to the amount of time spent alone. Given that working hours for evening and night work are highly regulated and can only be extended under restrictive conditions implies that available time cannot be substituted with more market work. Consequently, the individual is more likely to spend a higher fraction of his total free time alone. The probability p_i of a successful leisure match is highest if the working schedules of both potential leisure companions overlap as much as possible meaning that $H_{in} \to 0$.

For the derivation of the estimation equation, λ will be associated with the budget constraint as given by equation (2). Maximizing the expected utility function (6) subject to the time constraint (1) and the budget constraint (2) yields the first order condition for solitary leisure time:

$$\lambda w = \alpha_2 \Upsilon^A (A)^{\alpha_2 - 1}. \tag{8}$$

Taking logs and assuming that $\Upsilon^A = \mathbf{X}\rho + u$ yields, after re-arranging:

$$\log A = \theta + \delta \log w + \mathbf{X}\beta + \eta, \tag{9}$$

where $\theta = \frac{\log\lambda + \log\alpha_2}{\alpha_2 - 1}$, $\delta = \frac{1}{\alpha_2 - 1}$, $\beta = -\delta\rho$ and $\eta = -\delta u$. Let us assume that not the log of the total amount of leisure time spent alone is examined but rather the fraction of solitary leisure relative to the total amount of leisure time $(A + \sum_{i \in k} S_i)$. This fraction will henceforth be denoted by a. The

final estimation equation in matrix form can thus be formulated as:

$$a = \delta \log w + \mathbf{X}\beta_1 + \mathbf{H}\beta_2 + \beta_3 U + \epsilon, \tag{10}$$

where $\epsilon = \theta_A + \eta$ is a compound error term, individual characteristics are captured by predetermined individual characteristics **X** and household information **H**. U is an indicator variable denoting whether or not a person works during unusual hours. If preferences for solitary leisure of men who work during unusual working schedules do not differ systematically from those who work during normal working hours, the preference indicator θ is random and will therefore be part of the error term. Equation (10) can thus be estimated by simple OLS. If people with a higher preference for solitary leisure systematically select themselves into work during unusual schedules, estimates obtained by OLS are likely to be upward biased. The preference indicator θ will then be non-random and selectivity must be accounted for.

3 Data and Descriptive Statistics

The analysis of this paper is based on German Time Use Data (*Zeitbudgeterhebung*) for the year 2001/02 collected by the German Federal Statistical Office (Statistisches Bundesamt 2003). The data set is particularly interesting for the present study as it provides – apart from the usual socio-economic, work and household characteristics – detailed information about the timing of activities for each 10 minute time interval during a day for each respondent. An additional feature that makes this dataset particularly suitable to this study is the additional information about who each time slot is spent with. This allows me to directly infer from the data how much of the total leisure is indeed spent without company and when so. The analysis of this paper is restricted to full-time employed men aged between 25 and 59 in dependent employment.

Following Burda et al. (2007) the more than 200 daily activities are aggregated into four major categories: pure leisure, paid market work, household work and tertiary time of which the first three are relevant for the current study.[4] More specifically, pure leisure (L), which is also referred to as the narrow definition of leisure (Burda et al. 2006), comprises all activities that are pleasurable but that do not need to be undertaken at all and nobody can be paid to do them. It subsumes activities such as organized leisure activities,[5] sports, games, reading and writing, watching TV as

[4] Intervals of commuting or traveling time are added to the related activity. It can be further noted that an aggregation of the activities into these broad measures is inherently arbitrary.

[5] Organized leisure is defined as all those activities that involve amongst other things volunteerism or informal help for

well as listening to the radio. Market work (MW) is defined as all direct job related activities of primary and second jobs, but also comprises time spent on internships, qualification and education on or for the job, job search as well as breaks during the workday and work-related travel time. Other activity aggregates will not be regarded in more detail in this paper.

3.1 Description of the Variables

For the analysis of the influence of working schedules on social life two definitions will be used. The first group of workers with unusual working schedules comprises all shift workers. Each respondent indicates whether he works morning, evening, rotating or another kind of shift. All these categories are combined into a single indicator of shift work. A person belonging to this group will be referred to as *self-reported shift worker*. The relevant reference group consists of all men who do not report working shifts and will be called daytime workers from now on.

The second definition refers to all those men who work during non-standard hours. This information is directly derived from the diary information. Again, a person is defined to work during *unusual hours* if more than 30 percent of his total working hours lie outside this period.[6] To not wrongfully define people as working with unusual schedules because they generally work very long hours, I restrict the attention in this paper to those men who devote not more than 10 hours market work per day (see also Scheffel (2011)). The reference group for this group of workers consists of all other men and will be referred to as men who work during usual or normal working hours from now on.

The two groups of workers are yet not exclusive and table 1 shows the respective overlap. 67 percent of the men who work during unusual hours also report shift work and about 42 percent of the shift workers additionally work at non-standard hours. Among all those men who do not report working shifts, about 12 percent work during non-standard hours. Of those men who are defined to work during standard hours, about 19 percent also report shift work.

The diary information as well as information about who the respective time slot is spent with, make the dataset unique and particularly well-suited for this study. Yet, there are some shortcomings as no information on the employment history nor on job tenure is available. Hence, the data provides no information about the previous experience of shift work or the duration of the rota-

other households.

[6] The Bureau of Labor Statistics (BLS) suggests to define shift work as any schedule in which more than half of the hours fall outside of a period between 8 am and 4 pm (Mellor 1986). Since only full-time employed men are regarded and in order to have a large enough sample, men who work during unusual hours are defined, in contrast to the BLS, if more than 30 percent of working hours lie outside of the standard workday.

Table 1: Overlap between Shift Work and Men with Unusual Working Hours and the Respective Reference Groups.

	reported		
	shift workers	daytime workers	N
unusual hours	311	153	464
standard hours	455	1946	3154
N	766	2099	2807

tion schedule for men who work in rotating teams. These variables help to determine the risks of longer-run exposure to such jobs on social life. It is therefore likely that the results obtained here upward biased and are lower if it was possible to control for these influences.

I furthermore control for a number of standard predetermined demographic variables that have an impact on social life. These are the worker's age in 3 categories (younger than 35, 35-45 (reference group) and older than 45), educational attainment in three broad categories (low, medium (reference category) and high skills), a dummy for being married, for the presence of children under the age of 6 and for kids aged between 7 and 17 living in the household, for living in Western Germany as well as an indicator about whether or not the wife is not employed. Furthermore, I add the log of usual weekly working hours.

3.2 Sample Description

Descriptive statistics by worker group are reported in table 2. It shows that shift workers and men with unusual hours are slightly younger, less educated and tend to have slightly more kids.

Not only are shift workers and men who work during unusual hours different from the respective reference group but the two groups themselves differ considerably. Men who work during unusual hours are generally better educated than self-reported shift workers but they are also slightly less likely to be married and have slightly more kids. Shift workers are less likely to have kids under the age of 6 but tend to have a higher probability to have kids above the age of 6. Shift workers earn on average lower hourly wages but due to differences in educational levels, a mean comparison is not meaningful here.

Table 2: Summary Statistics.

	shift workers		**day workers**	
	reported	unusual	reported	usual
work information:				
unusual wrk hours	0.421	1.000	0.120	0.000
	(0.494)	(0.000)	(0.325)	(0.000)
shift work	1.000	0.670	0.000	0.190
	(0.000)	(0.471)	(0.000)	(0.392)
log hourly wage	2.426	2.493	2.528	2.526
	(0.368)	(0.498)	(0.478)	(0.428)
usual wrk. hrs (log)	3.664	3.659	3.698	3.673
	(0.177)	(0.316)	(0.265)	(0.216)
personal characteristics:				
age	42.848	42.836	43.462	43.447
	(7.083)	(7.707)	(7.743)	(7.631)
low skilled	0.044	0.054	0.013	0.013
	(0.206)	(0.226)	(0.111)	(0.113)
medium skilled	0.794	0.677	0.494	0.566
	(0.404)	(0.468)	(0.500)	(0.496)
high skilled	0.161	0.265	0.490	0.419
	(0.368)	(0.442)	(0.500)	(0.493)
married	0.837	0.819	0.810	0.821
	(0.370)	(0.385)	(0.392)	(0.384)
household information:				
# of kids	1.411	1.433	1.404	1.418
	(1.005)	(1.072)	(1.026)	(1.027)
kids under 6	0.185	0.192	0.180	0.185
	(0.389)	(0.394)	(0.384)	(0.389)
kids aged 6 – 17	0.474	0.422	0.422	0.434
	(0.500)	(0.494)	(0.494)	(0.496)
Western Germany	0.826	0.825	0.817	0.843
	(0.379)	(0.380)	(0.387)	(0.364)
observations	967	464	2948	2401

Standard deviations are given in parentheses.

3.3 The Timing of Activities

Figure 1 represents the distributions of working hours for self-reported shift workers (dashed line) and of men who work during unusual hours (solid line). The vertical lines indicate the standard workday as defined in this paper. The working hour distributions of men who work shifts or during unusual hours differ from each other which is particularly pronounced during the evening hours. As before, the average workday of shift workers tends to be slightly shifted to the left as compared

with the standard workday, i.e. it starts and finishes slightly earlier than the standard workday. Around 10 pm, the incidence of shift work amounts to about 25 percent. Work at night is less likely but still occurs with a probability of about 10 percent between midnight and 4 am. Men, who work during unusual hours, are most likely to work between 6 am and 10 pm. Around 10 pm, the probability to work is still pronounced and amounts to 40 percent. Hence, the figure suggests that it is not so much the incidence of work during nights that is expected to have the strongest adverse effect on social life and thus on social interaction, but rather work around the margins of the working hours distributions, i.e. the early morning and late evening hours.

Figure 1: Distribution of Working Hours by Worker Group.

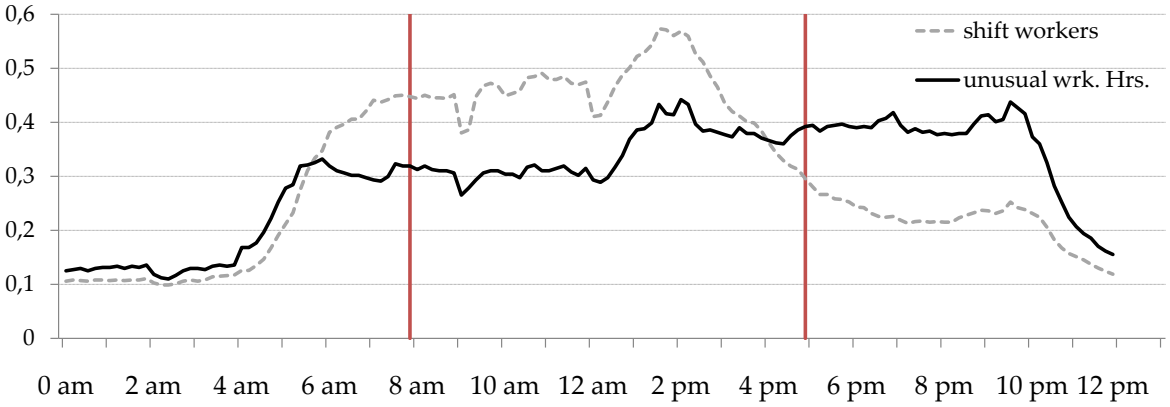
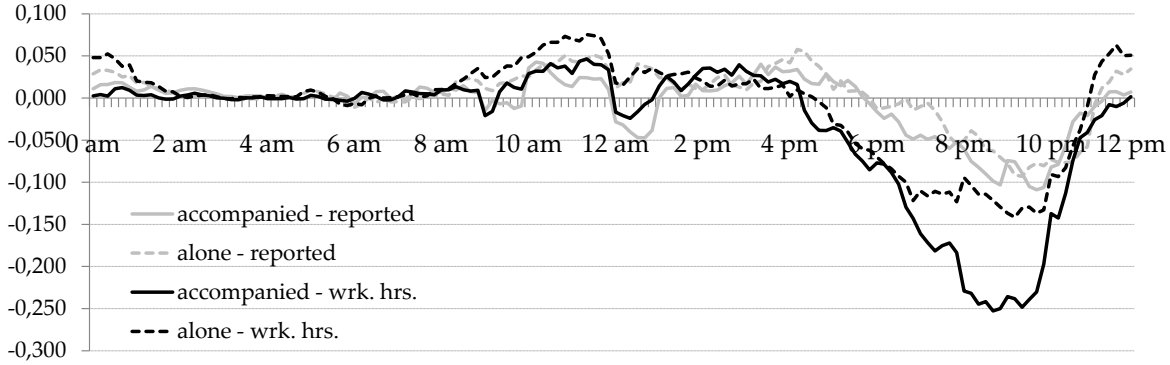


Figure 2: Differences in the Distribution of Accompanied and Unaccompanied Leisure for Men Who Work Shifts (Gray) and Who Work During Unusual Hours (Black) with the Respective Reference Group.



To visualize the interdependence between the allocation of market activities as well as solitary and accompanied leisure, figure 2 depicts differences in the incidence (F_t) at each time interval t for the standard workday between men who report working shifts (gray lines) and of men who work during unusual hours (black lines) from the respective reference group:

$$\Delta_t \quad = \quad F_t(U=1) - F_t(U=0), \tag{11}$$

Table 3: Selected Descriptive Statistics on the Timing of Leisure as well as Hours of General and Solitary Leisure and Market Work.

	all	**reported**		**working hours**	
		shift wrk	day wrk	unusual	usual
fraction of men enjoying leisure at:					
3 am	0.004	0.004	0.004	0.003	0.004
9 am	0.106	0.115	0.104	0.111	0.105
3 pm	0.066	0.097	0.058	0.100	0.057
9 pm	0.713	0.556	0.754	0.398	0.797
average daily hours:					
leisure	4.04	4.01	4.05	4.12	4.55
	(2.06)	(2.20)	(2.02)	(2.49)	(1.99)
solitary leisure	1.62	1.66	1.61	1.88	1.75
	(1.56)	(1.54)	(1.56)	(1.70)	(1.63)
market work	8.66	8.47	8.73	6.90	7.82
	(2.90)	(2.85)	(2.91)	(3.26)	(2.53)
sleep	7.17	7.21	7.16	7.60	7.21
	(1.43)	(1.78)	(1.29)	(2.01)	(1.36)
N	3915	967	2948	464	2401

Standard deviations are given in parentheses.

with U being a dummy variable that indicates whether the person works shifts or not or alternatively whether he works during unusual hours or not.[7] Straight lines represent differences in the incidence of accompanied leisure by time interval and dashed lines refer to differences in solitary leisure. The figure suggests that differences in the allocation of leisure between the groups of workers are highest in the later evening hours between 6 pm and 12 pm. Since the propensity to work is largest during these time intervals, the incidence leisure is significantly reduced. The differences are most pronounced for men who work during unusual hours and hence the incidence of accompanied leisure is most strongly diminished. Between 8pm and 10 pm accompanied leisure of this group of men is about 25 percent less likely as compared to the reference group. In contrast, leisure is enjoyed to a higher extent during standard working hours but is more likely to be spent alone which demonstrates the higher social disconnectedness of these workers. Since the average workday of shift workers starts and finishes slightly earlier than the average workday of all workers, also leisure is more likely to be enjoyed earlier.

As shown by table 3, full-time employed men spend about 4 hours of their daily available time on purely enjoyable activities (pure leisure). A comparison of average hours of leisure reveals no

[7] Dan Hamermesh has largely examined the impact of changes in working schedules over time for various countries and for various different questions (1996, 1999a, 1999b, 2002).

big difference between shift workers and the reference group. These workers are found to differ with respect to the *timing* of activities yet not the enjoyment in absolute hours. Men who work during unusual hours enjoy slightly more leisure and, workers who are defined to work during standard hours, in contrast, tend to spend almost half an hour more time than every other group.

The table additionally reports the amount of average actual daily working hours by group. It shows that men with unusual working hours tend to work on more than 1.5 hours less on average than men who report working shifts. The *Working Time Act (ArbZG)* restricts working hours of night work to 8 hours which can be extended to 10 hours per day provided that an average of 8 hours is maintained over a 6 months or 24 week period or alternatively in emergencies and extraordinary circumstances. This regulation might explain the lower average working hours of men who work with unusual schedules.[8] Also those men who work at standard hours yet not more than 10 per day are found to work on average only about 7.8 hours.

As mentioned before, sleep might be disrupted by unusual working schedules. Hence, table 3 presents the average hours of sleep by group. In total, all workers tend to spend about 7 hours sleeping without significant differences for shift and daytime workers. In contrast, men who work during unusual hours tend to spend significantly more time on this activity than all other groups of workers. One possible explanation is that these men substitute away their leisure time with sleep in order not to have even greater amounts of solitary leisure. In addition, work performed rather at the fringes of the workday yet not during nights does not disrupt the circadian cycle and thus the sleeping rhythm. A second explanation is therefore that workers with such schedules need to rest more in order to recover from the burden of work. In this context, more time devoted to sleep cannot be interpreted as a sign for an increased risk to health per se yet a longer exposure might aggravate stress and thus reduce well-being. The next section will explore these possible explanations in more detail. Besides, it needs to be mentioned that the standard deviations of the amount of sleep are strongly elevated for shift workers and for men who work during unusual hours. The dispersion is thus stronger and will also be explored more closely.

In addition, table 3 reports the average hours of time that men spent without company on solitary leisure. Even though men with unusual working schedules devote on average less time to market work and enjoy similar hours of leisure than the average worker, they simultaneously spent more of their total alone. In addition to this, table 4 shows the fraction of solitary leisure relative to the total amount of time spent on purely enjoyable activities. All men spend on average

[8] See also §6 of the Arbeitszeitgesetz (ArbZG).

Table 4: Fractions of Solitary Leisure by Age Group and Mean Earnings.

	all	**reported**		**working hours**	
		shift wrk	day wrk	unusual	usual
solo leisure: all	0.411	0.432	0.403	0.477	0.388
	(0.326)	(0.329)	(0.325)	(0.319)	(0.313)
by age group:					
solo leisure: ≤ 35	0.418	0.417	0.419	0.448	0.381
	(0.334)	(0.324)	(0.337)	(0.313)	(0.311)
solo leisure: 35 – 45	0.396	0.439	0.378	0.493	0.372
	(0.322)	(0.334)	(0.316)	(0.317)	(0.308)
solo leisure: ≥ 45	0.424	0.427	0.423	0.471	0.407
	(0.328)	(0.323)	(0.329)	(0.326)	(0.319)
by position in the wage distribution:					
solitary leisure: ≤ 50 %	0.443	0.428	0.449	0.493	0.415
	(0.347)	(0.356)	(0.344)	(0.330)	(0.336)
solitary leisure: ≥ 50 %	0.412	0.436	0.403	0.471	0.401
	(0.316)	(0.311)	(0.318)	(0.323)	(0.308)

Standard deviations are given in parentheses.

about 41 percent of their total leisure time alone. This fraction is 2 – 6 percentage points higher for shift workers and for men with unusual working schedules. In contrast, solitary leisure fractions of those men belonging to the respective reference groups are significantly lower in particular men who work during the standard workday.

The table further reports differences in the fraction of solitary leisure by age group. It shows that solo leisure is generally lowest for workers aged 35 – 45 and is highest for workers older than 45. While the timing of solitary leisure of shift workers does not seem to differ for workers belonging to the youngest and oldest age group, prime age shift workers tend to spend on average about 6 percentage points more of their total leisure time alone. When it comes to men who work during unusual hours, the table reveals that these men tend to have always higher fractions independent of the age group. Differences in the unconditional means are again highest for prime aged men who tend to have 12.1 percentage points higher fractions of solitary leisure.

Table 4 also depicts unconditional means for the fraction of solitary leisure by position in the wage distribution. Solitary leisure fractions are highest for workers who earn lower than median wages. Shift workers in the lower half of the wage distribution are slightly less alone than the reference group yet the relationship is reversed for the upper 50 percent. The picture is very different

for men who work during non-standard hours. Those men who have than median earnings spent almost half of their total leisure time without company. In contrast, men with standard working hours have on average 7 – 8 percentage points lower fractions of unconditional solitary leisure. In the following section, I will analyze in more detail whether there is evidence that young workers accept unusual working schedules from an investment perspective to accumulate additional income (see also Scheffel (2011)).

4 How is the Social Life Affected?

Work at unusual hours complicates social interactions with others as it gets increasingly more difficult and hence more costly to find suitable leisure companions (Jenkins and Osberg 2005, Burda and Weil 2005). The result is a deterioration of social capital (Putnam 1995, Burda 2000). The theoretical motivation suggests that the utility derived from social leisure decreases for these workers. The magnitude of the resulting decrease in marginal utility depends on the general distribution of working hours as well as of the working schedules of friends and family but also on individual preferences. The widening of the working hour distribution which has positive influences on output from the firm's perspective is however outweighed to some extent by additional negative externalities on the employee's overall well-being. In the medium and long-run, even individual health and therefore productivity of workers might be impaired which further adversely affects firms. Jenkins and Osberg (2005) argue furthermore that working hours unambiguously increase when social leisure is harder to arrange which implies that workers substitute leisure by additional work. The predictions for the determination of the sign of the impact on solitary leisure are however not clear-cut. The reason is that each person is not only affected by his own working schedules but also by those of potential leisure companions. To account for these differences in the absolute amount of time, I will estimating the impact of working schedules on solitary leisure relative to the total amount of leisure time as reported by equation (10).

4.1 Results for all Workers

Coefficient estimates of the group identifier variable are reported in table 5. Each entry corresponds to an estimate of the indicator variable of separate regressions. The first column of the table reports differences in the fraction of solitary leisure for the respective groups. Accordingly, shift workers tend to have 3.8 percentage points higher fractions of leisure without company. Among all

shift workers, about 59 percent work also during standard hours so that the organization of social leisure is allegedly easier on average given the general distribution of working hours. The estimates are about 5 percentage points higher for men who work during unusual hours and the difference amounts to 9 percentage. Since only workers who work not more than 10 hours per day are considered, the overlap of leisure with potential leisure companions is likely to be more difficult and hence the organization of leisure matches.

Table 5: Coefficient Estimates of the Group Indicator on the Fraction of Solitary Leisure (1) and Marginal Effects of the Satisfaction with the Allocation of Time Devoted to Work (2), Leisure (3) and Friends (4).

	fraction of solo leisure	**satisfaction w/ timing of work**	**leisure**	**friends**
	(1)	(2)	(3)	(4)
self-reported shift workers	0.038*	-0.050*	0.028	-0.027
	(3.15)	(2.55)	(1.43)	(1.37)
workers with unusual hours	0.089*	-0.061*	0.010	-0.033
	(5.55)	(2.96)	(0.40)	(1.24)

Absolute t or z-statistics in parentheses. * indicate significance levels of 10 % or higher; standard errors are robust. Also included in the regressions: age group dummies, skill indicators, dummies for being married, having children and having kids under the age of 6 and between 6 – 17, Western Germany, a non-employed wife, the log normal working hours.

Moreover, table 15 shows that no non-random selection occurs which suggests that workers among the different groups are not systematically different in their unobserved components. The estimates show that the inverse Mill's ratios of a treatment effect models are not significantly different from zero. The exclusion restriction for the choice to work shifts or during unusual hours defined as the rate of shift work or work during unusual hours by occupation and sector in 1991/92. These exclusion restrictions capture differences in the occupation- and sector-specific tendencies of shift work or work during unusual hours and thus reflect differences in the preferences among workers of the different occupations. The estimates for this term are highly significant. It can hence be concluded that it is sufficient to concentrate on the OLS estimates in the remainder of this paper.

The remaining determinants of solitary leisure are reported in table 6. Accordingly, age and skill levels do not affect the fractions of solo leisure significantly. The only exception is that men under the age of 35 tend to have lower fractions of solo leisure. The estimate is significant when working schedules are regarded as shown in column (2) of the table. Married men, those with kids as well as men who have a non-employed wife tend to have lower fractions, which is unsurprising given

that these characteristics facilitate social interaction. Longer average weekly working hours are found to have a different impact depending on whether shift workers or men with unusual hours are considered. In addition, men who live in households with kids tend to spend less leisure alone. The table reveals that parents with kids under the age of 6 have about 9 percentage points lower fractions. Households with kids above the age of 6 tend to spend on average 5 – 6 percentage points less solo leisure. Moreover, the region of residence does not when fractions of unaccompanied leisure time are regarded.

To gain a better understanding of the potential role of preferences, I further examine differences with respect to the satisfaction with the allocation of time for different domains. The combination of these results might help to gain further insights into potential consequences on the marginal utility of leisure and even on well-being. Table 5 reports marginal effects of the indicator variable from probit models on the satisfaction with the allocation of time devoted to work (2), leisure (3) and friends (4).[9] These estimates show that men who work shifts tend to be on average about 5 percent less satisfied with the allocation of their working hours as compared to the reference group. Men with unusual working hours even tend to have 6.1 percentage points lower levels of satisfaction. These estimates refer to differences in the satisfaction with the *timing* of work. Hence the results underline the findings Scheffel (2011) according to which workers choose such jobs because of the higher associated wages yet not because of differences in preferences.

Moreover, the last column of table 5 reports differences with respect to the levels of satisfaction with the allocation of time with friends. Both groups, shift workers and men with unusual hours, tend to report lower average satisfaction levels which are not significant though. Finally, when the satisfaction with the allocation of leisure is regarded, as reported by column (3), no significant differences can be found between these men and the respective reference groups. Shift workers report slightly higher but insignificant levels of leisure time satisfaction yet almost no differences are found for men who work during unusual hours. The combination of these last findings emphasizes the earlier made assumption that workers do not choose to work shifts or during unusual hours due to different preferences for social leisure. In fact, the resulting working schedules of these jobs are disruptive in terms of social interaction and hence are likely to reduce the marginal utility that people derive from such jobs.

The remaining determinants of the separate satisfaction regressions are reported in table 7. It shows that men who are younger than 35 and to some extent also those older than 45 are more satisfied with the timing of their working hours as the reference group. Older men, in addition also

[9] Men are defined to be satisfied with the time allocation for market work, leisure and friends when they report higher than average satisfaction levels. All others are reported as being not satisfied.

Table 6: Determinants of Solitary Leisure for Shift Workers and Men with Unusual Working Hours.

	shift work work (1)	**unusual wrk. hrs** (2)
shift indicator:		
indicator	0.038*	0.089*
	(3.15)	(5.55)
personal characteristics:		
age: ≤ 35	-0.019	-0.037*
	(1.17)	(2.05)
age: > 45	0.002	0.000
	(0.16)	(0.00)
low skilled	0.001	0.024
	(0.03)	(0.53)
high skilled	-0.012	0.016
	(0.70)	(0.87)
married	-0.190*	-0.164*
	(10.28)	(7.99)
household information:		
kids under 6	-0.096*	-0.092*
	(5.40)	(4.81)
kids 6-17	-0.059*	-0.050*
	(4.42)	(3.35)
Western Germany	0.001	0.017
	(0.03)	(0.74)
not employed partner	-0.048*	-0.057*
	(4.16)	(4.44)
work information:		
normal wrk. hrs (log)	0.031*	-0.023*
	(0.76)	(0.51)
constant	0.775*	0.769*
	(8.76)	(8.77)
observations	3866	2834
R^2	0.085	0.090

Absolute t-statistics in parentheses. * indicate significance levels of 10 % or higher; standard errors are robust.

tend to be marginally more satisfied with the allocation of personal leisure although the coefficient is not very accurately measured. Married men and those with a non-working wife further tend to report higher levels of satisfaction. Coordination within such couples or finding a suitable leisure companion is on average easier which is reflected by the higher levels of satisfaction with

the allocation of time for leisure and friends. In contrast, men with children and in particular with children younger than 6 tend to report lower average satisfaction levels. This suggests that reconciliation of work, family and friends is more difficult for these men. In addition, lower skilled workers tend to devote significantly lower satisfaction with the allocation of leisure. However, it must be noted, that lower educated workers tend to report in general lower levels of satisfaction (Blanchflower and Oswald 2004).

Table 7: Marginal Effects for the Determinants of Satisfaction with the Allocation of Time Devoted to...

	shift workers			**working hours**		
	... work	... leisure	... friends	... work	... leisure	... friends
	(1)	(2)	(3)	(4)	(5)	(6)
shift indicator:						
indicator	-0.050*	0.028*	-0.027	-0.063*	-0.010	-0.033
	(2.55)	(1.43)	(1.31)	(1.37)	(0.40)	(1.24)
personal characteristics:						
age: ≤ 35	0.129*	0.014	-0.023	0.119*	0.015	-0.017
	(5.10)	(0.56)	(0.89)	(3.94)	(0.50)	(0.55)
age: > 45	0.030	0.031	0.011	0.072*	0.021	0.022
	(1.50)	(1.60)	(0.55)	(3.12)	(0.92)	(0.95)
low skilled	-0.023	-0.110*	0.024	-0.060	-0.135*	-0.004
	(0.38)	(1.87)	(0.38)	(0.82)	(1.89)	(0.05)
high skilled	-0.036	-0.027	0.014*	-0.034	0.009	0.003
	(1.26)	(0.96)	(0.48)	(1.08)	(0.28)	(0.09)
married	0.055*	0.026	0.088*	0.053*	0.015	0.046
	(1.99)	(0.94)	(3.18)	(1.67)	(0.50)	(1.44)
household information:						
kids under 6	-0.098*	-0.166*	-0.101*	-0.030	-0.119*	-0.084*
	(3.45)	(5.90)	(3.52)	(0.91)	(3.16)	(2.53)
kids 6-17	-0.046*	-0.047*	-0.030	-0.024	0.028	-0.005
	(2.21)	(2.25)	(1.37)	(0.99)	(0.98)	(0.21)
Western Germany	0.003	0.081*	0.122*	-0.029	0.073*	0.130*
	(0.10)	(2.36)	(3.53)	(0.75)	(2.94)	(3.38)
not employed partner	0.042*	0.042*	0.027	0.030	0.054*	0.042*
	(2.15)	(2.18)	(1.35)	(1.34)	(2.39)	(1.84)
work information:						
log avg. wrk. hrs	-0.033	-0.156*	-0.280*	-0.086	0.003	-0.303*
	(0.47)	(2.23)	(4.01)	(1.05)	(0.08)	(3.69)
observations	3803	3847	3727	2783	2825	2729
R^2	0.010	0.018	0.012	0.011	0.015	0.014

Absolute z-statistics in parentheses. * indicate significance levels of 10 % or higher; standard errors are robust.

The combination of these results is interesting and sheds more light on the potential underlying preferences for spending time alone. A coordination of schedules with others is easier and less costly for married men who consequently tend to spend lower fractions of their total leisure time

alone. They additionally tend to be more satisfied with the allocation of working hours and with the time spent with friends. The same holds for men with non-employed wives as these women can more flexibly adapt their schedules to match their husbands' which facilitates the coordination and hence increases utility derived from leisure. This is in accordance with Sullivan (1996) who finds that people derive the highest levels of utility from spending leisure with the spouse. Men with children also tend to have lower fractions of solo leisure yet it seems harder for them to combine family and work. This is reflected by the generally lower levels of satisfaction with the allocation of work, leisure and friends. Men under the age of 35 also tend to spend lower though only partly significant fractions of their total leisure time alone. In addition, they tend to be more satisfied with the timing of their working hours. One might argue that full-time employed men in this age group are more career-oriented and tend to be more idealistic than workers in other age groups. Table 7 further reveals that West Germans tend to be more satisfied with the allocation of time devoted to leisure and friends as compared to East German workers even though there are no differences in the fraction of solitary leisure. Finally, longer average weekly working hours are positively associated with aloneness fractions of shift workers but negatively with levels of satisfaction. In contrast, longer average working hours in the case of men who work with unusual schedules tend to be associated with lower average levels of solitary leisure but the influence on levels of satisfaction is also negative.

Determinants of solitary leisure might be entirely different for workers belonging to the separate groups. To test this possibility, table 8 represents separate estimation results for shift and daytime workers as well as for men with usual and unusual working hours. An F-test of equality for all coefficients as reported by the last line of this table can clearly reject it at 10 percent significant levels for all groups. Hence, the overall impact of the explanatory variables on solitary leisure differs considerably between the respective groups. The determinants should consequently be analyzed separately.

The differences in the determinants are presented in table 8 as well as single t-tests for each coefficient between the two separate equations in column (3). The table shows that while shift workers above the age of 45 have generally lower levels of solitary leisure, the opposite holds for men who work during the day. In addition, married shift workers and those with a non-employed wife have significantly lower fractions when they work during the day which suggests that shift has a more disruptive influence on social leisure and hence hampers the reconciliation of family and work considerably. Section 4.2 is devoted to further examine such influences. Column (6) shows

Table 8: Determinants of Solitary Leisure by Group and p-Values of a t-test for Equality.

	shift workers			**unusual hours**		
	shift	day	test	unusual	usual	test
	(1)	(2)	(3)	(4)	(5)	(6)
personal characteristics:						
age: ≤ 35	-0.038	-0.018	0.568	-0.042	-0.042*	0.985
	(1.26)	(0.94)		(1.06)	(2.12)	
age: > 45	-0.042*	0.023	0.027	-0.052	0.013	0.119
	(1.66)	(1.58)		(1.34)	(0.87)	
low skilled	-0.042	-0.008	0.648	-0.015	0.036	0.567
	(0.76)	(0.15)		(0.67)	(0.64)	
high skilled	0.025	0.024*	0.968	-0.023	0.044*	0.064
	(0.97)	(2.04)		(0.67)	(3.53)	
married	-0.119*	-0.186*	0.066	-0.118*	-0.162*	0.366
	(3.81)	(9.54)		(2.64)	(8.04)	
household information:						
kids under 6	-0.118*	-0.080*	0.332	-0.121*	-0.080*	0.435
	(3.81)	(3.86)		(2.49)	(3.85)	
kids 6-17	-0.060*	-0.052*	0.793	-0.010	-0.053*	0.300
	(2.39)	(3.36)		(0.26)	(3.34)	
Western Germany	0.042	0.043*	0.969	-0.008	0.049*	0.168
	(1.56)	(2.90)		(0.21)	(2.91)	
partner not empl.	-0.135*	-0.018	0.000	-0.106*	-0.047*	0.094
	(5.79)	(1.34)		(3.26)	(3.39)	
work information:						
log normal wrk. hrs	0.008	-0.070*	0.199	-0.054	-0.081*	0.534
	(0.14)	(3.80)		(1.46)	(3.55)	
observations	3866			2834		
p-value for equality	0.008			0.067		

Absolute t-statistics in parentheses. * indicate significance levels of 10 % or higher; errors are robust.

differences in the determinants of solitary leisure between men who work during standard and those with non-standard working hours. It follows that high skilled men who work during unusual hours differ significantly in their fractions of solitary leisure. While those who work at unusual hours have lower fractions, they tend to be less alone when they work during normal hours. Like before, men with unusual hours without an employed partner tend to have significantly less negative estimates of solitary leisure as compared to men who work at standard hours. This further underlines the disruptive influence of such schedules in the possibility for social interaction.

4.2 Results when Coordination is Less Costly

As described above, married men and those with kids tend to have significantly lower levels of solitary leisure. Coordination is clearly less costly for these men as potential leisure companions can always be found in the same household. Yet, the results also suggest that the timing of market work is crucial. To test whether the overall results shown so far are driven by these coordination advantages and also to explore how disruptive these schedules are, I will now examine the impact of the allocation of work by marital status and the presence of children.

Results are reported in table 9. While married shift workers tend to spend about 5.3 percentage points more on solitary leisure, no significant differences are obtained for non-married shift workers. In addition, men who work with unusual schedules are found to have 8 percentage points higher fractions of solitary leisure when they are married but also non-married men tend to spend about 6 percentage points more time alone. The estimate is however not very accurately measured.

It must be noted in this context, that married workers tend to be on average older than singles. Younger workers in contrast are generally more flexible with respect to the organization of non-working schedules and it follows that it is hence likely to be easier to find potential leisure companions. Social coordination is thus easier to arrange which mitigates the adverse consequences arising from unusual working schedules. This might partly explain the strong differences among shift workers. The fact that the difference among married and non-married men with unusual working schedules is not very large further indicated that such working schedules are indeed disruptive and significantly hamper the coordination of schedules and consequently the reconciliation of family and work. It shall be noted here that work during unusual hours and social interaction with others is likely to be endogenous. If married men choose to work during unusual hours to avoid their families, coefficient estimates are likely to be biased. The coefficient estimates tend to be upward biased here but suitable instruments are hard to find.

The last two columns of table 9 show differences in the extent of solitary leisure for men with and without children. Shift workers with kids, tend to have on average about 5.6 percentage points higher fractions. Among those shift workers without kids, no difference in the solitary leisure fractions of any kind is found. Fathers who work during unusual hours have larger difficulties to reconcile family life and work in that they have 9.7 percentage points higher fractions. For these men having no kids is associated with slightly though insignificantly higher solitary leisure fractions.

In general, men without kids under the age of 18 are either very younger or rather old. On average, these men tend to be older than the group of fathers. The possibility for social coordination is

Table 9: Coefficient Estimates of the Group Indicator on the Fraction of Solitary Leisure by Marital Status and the Presence of Children.

		married		**with children**	
		yes	no	yes	no
Ordinary Least Squares (OLS)					
(1)	self-reported shift workers	0.053*	0.014	0.056*	-0.001
		(3.95)	(0.46)	(4.14)	(0.04)
	N	2961	893	3151	703
(2)	workers with unusual hours	0.080*	0.062	0.097*	0.023
		(4.12)	(1.49)	(4.85)	(0.63)
	N	2319	506	2163	662

Absolute t-statistics in parentheses. * indicate significance levels of 10 % or higher; errors are robust. Also included in the regressions: age group dummies, skill indicators, dummies for being married, having kids under the age of 6 and between 6 – 17, Western Germany, a non-employed wife and the log normal working hours.

facilitated for fathers as here again potential leisure matches live in the same household. Yet, children under the age of 18 have on average shorter waking periods than their parents, which limits the possibility of leisure time overlap in particular if fathers work during non-standard hours. It follows that the family life in such cases is strongly adversely affected which is reflected by the significantly higher fractions of solitary leisure. In addition, with growing age, children tend to not consider their parents as suitable leisure companion which further limits the possibility for social interaction and might potentially upward bias the coefficient estimates.

4.3 Can Consequences on Solitary Leisure be Regarded as Career Investment?

For some time, workers in particular when they are younger, might accept higher fractions of solitary leisure to reap the benefits from the higher hourly wage rates from an investment perspective. To analyze this hypothesis, I divide the sample by earnings into those with higher or lower than median earnings. Table 4 shows in addition that it is prime-age workers (35 – 45 years) who tend to have highest unconditional average fractions of solitary leisure. I therefore add an interaction term between the indicator variable and a dummy for workers under the age of 45 to shed further light on this hypothesis.

Columns (1) and (3) of table 10 report the estimates of the differences in solitary leisure between the respective groups by position in the wage distribution. They reveal that the augmented over-

Table 10: Coefficient Estimates of the Group Identifier on the Fraction of Solitary Leisure by Median Earnings and Age Group.

	lower 50%		**upper 50%**	
	(1)	(2)	(3)	(4)
shift worker:				
shift workers	-0.009	0.007	0.049*	0.012
	(0.35)	(0.16)	(2.74)	(0.41)
shift*(younger 45)		-0.023		0.062*
		(0.44)		(1.78)
N	970	970	1842	1842
R^2	0.096	0.096	0.092	0.093
unusual working hours:				
unusual hrs	0.078*	0.130*	0.080*	0.042
	(2.17)	(2.27)	(3.56)	(1.11)
unusual*(younger 45)		-0.085		0.065
		(1.16)		(1.37)
N	684	684	1410	1410
R^2	0.088	0.090	0.103	0.104

Absolute t-statistics in parentheses. * indicate significance levels of 10 % or higher; errors are robust. Also included in the regressions: an age group dummy for being younger than 45, skill indicators, dummies for being married, having kids under the age of 6, and between 6 – 17, Western Germany, a non-employed wife, log normal working hours.

all fractions of unaccompanied leisure in the case of shift workers are mainly driven by men with higher than median earnings. The aloneness fraction for such shift workers is on average 4.9 percentage points higher. In contrast, independent of the position in the wage distribution, men with unusual schedules all tend to have about 8 percentage points higher fractions of solitary leisure.

Career concerns play a more important role for younger workers who are hence more likely to accept the consequences of their working schedules as investment. Scheffel (2011) has shown some evidence that workers with less favorable characteristics select themselves into such jobs because of the higher wage differentials yet not because of comparative advantage for work with unusual schedules. It can be argued that the workers accumulate the financial benefits from such jobs at lower ages which will further allow them to use their accumulated earnings potential when they are older to avoid work during such hours.

Moreover, columns (2) and (4) of table 10 report coefficient estimates of separate regressions including the interaction term between the group identifier and the age dummy. Shift workers with lower than median earnings are again not found to significantly differ from daytime workers with respect to solitary leisure. Also the interaction term is insignificant yet negative which indicates

that men under the age of 45 have spend less of their total leisure time without others. Men belonging to this age group are relatively flexible so that it can be argued that social interaction tends to be easier. For men in the upper half of the wage distribution, it is the age interaction term that seems to be responsible for the higher share of solitary leisure. The estimates reveal that younger shift workers with higher than median earnings tend to have on average about 6.2 percentage points higher fractions of solo leisure but the shift indicator itself has a negligibly small influence. These findings can be understood as indication to support the earlier hypothesis that younger shift workers with higher than median earnings to accept the higher fraction of solo leisure as investment into their careers.

Figure 3: Incidence of Shift Work and Work during Unusual Hours by Age Group.

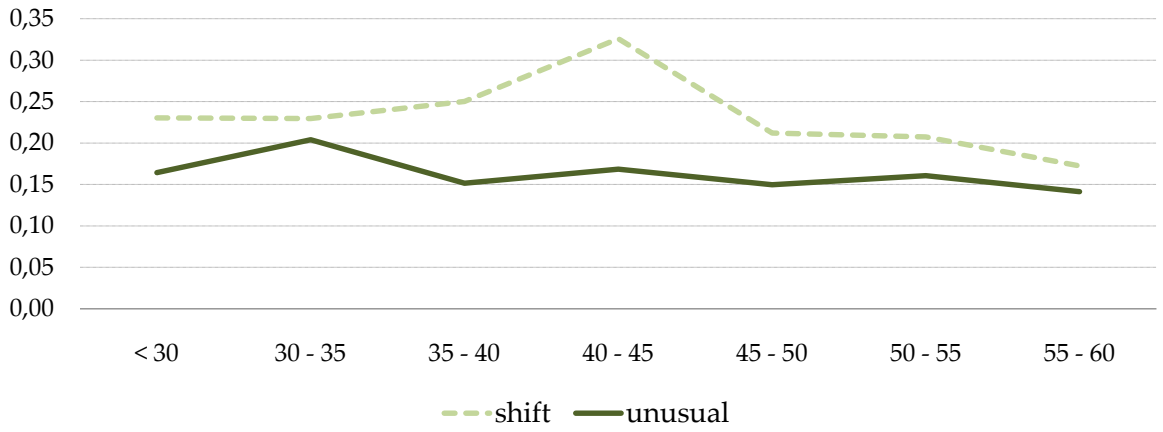


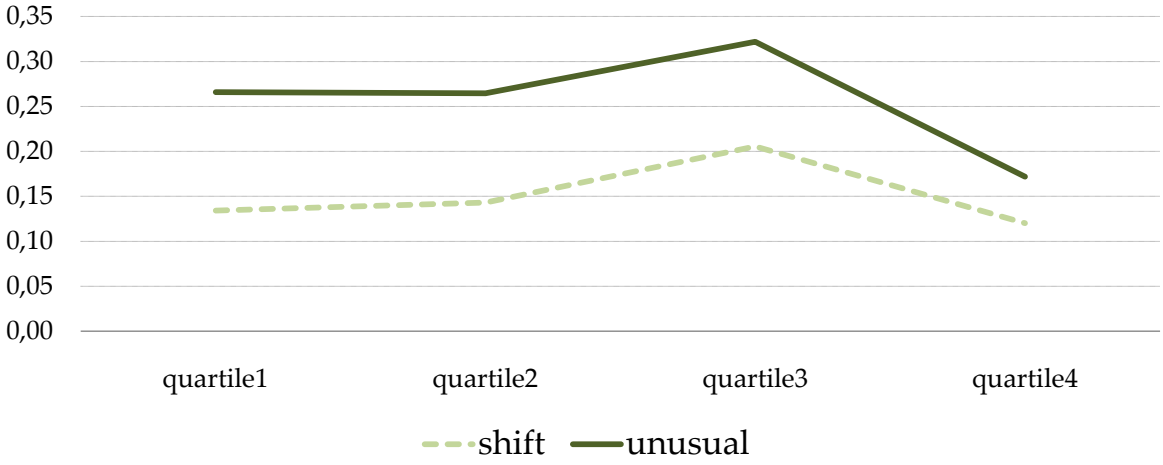
Figure 3 additionally depicts the share of shift workers and men with unusual working hours by age group. The incidence of work at unusual hours is relatively uniformly distributed across the age groups for all men older than 35 and is slightly augmented for younger men. The rate of shift work, in contrast, increases up to the age of 45 and decreases again for older men.[10] These patterns emphasize that age plays some role and that a divide into younger and older men is meaningful. Yet, the difference in the incidence of such working schedules does not seem to drive the results.

When it comes to men who work during unusual hours, the table shows that the size of the coefficient estimate of the indicator variable strongly increases for men in the lower half of the wage distribution when the age interaction term is added. Like before, the interaction term itself shows that younger shift workers tend to have lower fractions of solitary leisure. The coefficient estimate is however not precisely estimated but is sizeable. In contrast, workers below the age of 45 with unusual hours and above median earnings tend to have higher levels of solitary leisure than older

[10] The estimates are robust when workers aged 40 – 45 are excluded from the estimation for who the shift incidence is highest.

men exposed to such working schedules. Yet, the estimate is not very accurate measured. Since higher levels of solitary leisure are obtained for all workers with unusual schedules, independent of age, it is difficult to disentangle the investment hypothesis for younger men.

Figure 4: Incidence of Shift Work and Work During Unusual Hours by Quartile of the Earnings Distribution.



It follows that shift workers but to a greater extent men with non-standard working schedules independent of their position in the wage distribution tend to have higher fractions of solitary leisure. In particular, there is evidence that younger men with higher than median incomes seem to accept the consequences of work during unusual hours on social life from an investment perspective.

Finally, figure 4 reports the rate of shift workers and of work at unusual working hours by quartile of the wage distribution. These rates are relatively stable for earnings below the median and are slightly augmented for the third quartile so that it can be argued that the results are not driven by changes in the incidence across the wage distribution. However, Scheffel (2011) has shown that men with less favorable labor market characteristics are slightly more likely to accept such jobs for the augmented monetary compensation. In addition, these workers have to disproportionately bear the adverse effects of such working schedules on the private life. It can hence be argued that less advantaged workers with lower than median wages have an augmented risk of marginalization.

4.4 Long-Run Risks

Potential adverse consequences of shift work on health are extensively studied in the medical literature (Minors et al. 1986, Cunningham 1989, Skipper et al. 1990, Costa 1996, 2003, Folkard and

Table 11: Coefficient Estimates of the Fraction of Solitary Leisure on Minutes of Sleep.

	all	**shift**	**unusual**
	(1)	(2)	(3)
solitary leisure	21.363*	17.761*	20.434*
	(4.96)	(3.83)	(4.47)
(solitary leisure)*(indicator)		12.692*	3.720
		(2.11)	(0.60)

Absolute t-statistics in parentheses. * indicate significance levels of 10 % or higher; standard errors are robust. Also included in the regressions: age group dummies, skill indicators, dummies for being married, having children and having kids under the age of 6 and between 6 – 17, Western Germany, a non-employed wife, the log normal working hours, log hourly wages and the month of the interview.

Tucker 2003). In general, such working schedules disrupt the circadian cycle which implies sleepiness throughout the whole day. This might be reflected by longer sleeping intervals. If, in contrast, people are exposed to such working hours for too long, sleeping problems are likely to exacerbate even further. According to the medical literature, workers with longer job tenures in such jobs are likely to have interrupted sleeping intervals and to suffer from sleep deprivation (Härmä et al. 1998, Åkerstedt 2003).

In the remainder of this section, I will therefore use the amount of time devoted to sleeping as a proxy for potential long-run consequences of such jobs in particular regarding the health related risks. To get a first impression about the association between sleep and aloneness ratios, the first column of table 11 reports the coefficient estimates of the fraction of solitary leisure on minutes of sleep. The table shows that higher levels of unaccompanied free time are positively correlated with minutes of sleep. An increase in the fraction of solitary leisure by 1 percentage point increases sleep by more than 20 minutes per day. One explanation for this positive association could be that people who spend higher fractions of their total leisure alone, substitute sleep to some extent for free time to not having even higher fractions of solitary leisure. In this respect, positive associations do not directly hint at augmented levels of risk to mental health. In fact, on the contrary sleep might even have a therapeutic function (Bird and Fremont 1991).

The table further shows different regression by including an additional interaction term between the fraction of solitary leisure and an indicator for either working shifts (column (2)) or for work at unusual hours (column (3)). The table shows that the inclusion of an interaction term

results in a significant and positive impact of solitary leisure fractions on the time devoted to sleep. The interaction term itself is also positive but only significant for shift workers. This indicates that shift worker have a greater response of spending leisure time alone on minutes of sleep. Men with unusual hours, in contrast, do not differ significantly. In other words, men who work during unusual hours and who spend higher fractions of their leisure time alone substitute with similar amounts of time devoted more to sleep.

Moreover, 12 reports the influence between the fraction of solitary leisure on sleep by worker group. The previous results are underlined so that an increase in solitary leisure by 1 percentage point is associated with an increase in sleep by 39 (15) minutes for shift (daytime) workers. Column (3) additionally reports the p-values for equality of the coefficient estimate between the two equations. The t-test suggests that equality of the coefficient estimate for shift and daytime workers can be rejected and consequently shift workers allocate more of their total time sleeping when they have higher fractions of solitary leisure. In other words, shift workers compensate aloneness to a greater extent with more sleep than daytime workers which corroborates the earlier made substitution hypothesis. In addition, columns (4) and (5) emphasize the previous finding according to which workers tend to sleep on average more when they have higher fractions of solitary leisure. Now this time, the result is independent of whether or not the person works during standard or non-standard hours.

The table also reports differences in the association between solitary leisure and sleep by age and worker group. The correlation is strongest for men younger than 35 but in particular for men who work shifts (54 minutes more sleep) and who work at unusual hours (66 more minutes of sleep). The impact weakens however with increasing age. The coefficient estimates by age group is not found to differ significantly for the different groups of workers which is mainly due to the restricted number of observations. The differences in the impact of solitary leisure fractions on sleep are only found to vary significantly for prime aged shift workers. In this case, shift workers substitute their time to a much greater extent with sleep than daytime workers. The difference between these two groups amounts to more than 30 minutes.

Until so far, only differences in the average aloneness fractions on the average minutes of sleep were explored. Higher risks to mental health determine however rather the extreme quantiles of the sleep time distribution. Hence, figure 5 presents differences in the estimates of the fraction of solitary leisure by sleep quantile between the groups of workers and the respective reference group. Positive values indicate that the estimates are higher for shift workers or men with unusual

Table 12: Coefficient Estimates of the Fraction of Solitary Leisure on Minutes of Sleep by Worker Group.

	shift workers			**unusual hours**		
	day	shift	test	usual	ususual	test
	(1)	(2)	(3)	(4)	(5)	(6)
all workers:						
	15.567*	38.984*	0.057	24.527*	34.163*	0.630
	(3.28)	(3.44)		(4.20)	(1.79)	
by age group:						
under 35	12.518	54.370	0.268	31.347*	66.278	0.507
	(1.15)	(1.50)		(1.99)	(1.32)	
35 – 45	10.313	47.325*	0.045	27.380*	46.655	0.552
	(1.25)	(2.87)		(2.71)	(1.51)	
above 45	9.975	22.786*	0.495	28.087	20.829*	0.789
	(0.57)	(3.52)		(1.07)	(2.81)	

Absolute t-statistics in parentheses. * indicate significance levels of 10 % or higher; standard errors are robust. Also included in the regressions: age group dummies, skill indicators, dummies for being married, having children and having kids under the age of 6 and between 6 – 17, Western Germany, a non-employed wife, the log normal working hours, log hourly wages and the month of the interview.

Figure 5: Coefficient Estimates of the Fraction of Solitary Leisure by Decile of the Sleep Time Distribution.

hours and vice versa. It is interesting to note that for men in the lower parts of the sleep distribution, solitary leisure is slightly though insignificantly correlated with less sleep when differences between workers with standard and non-standard hours are explored. In general, up to the median minutes of sleep, differences are insignificant and low. Substitution between free time and

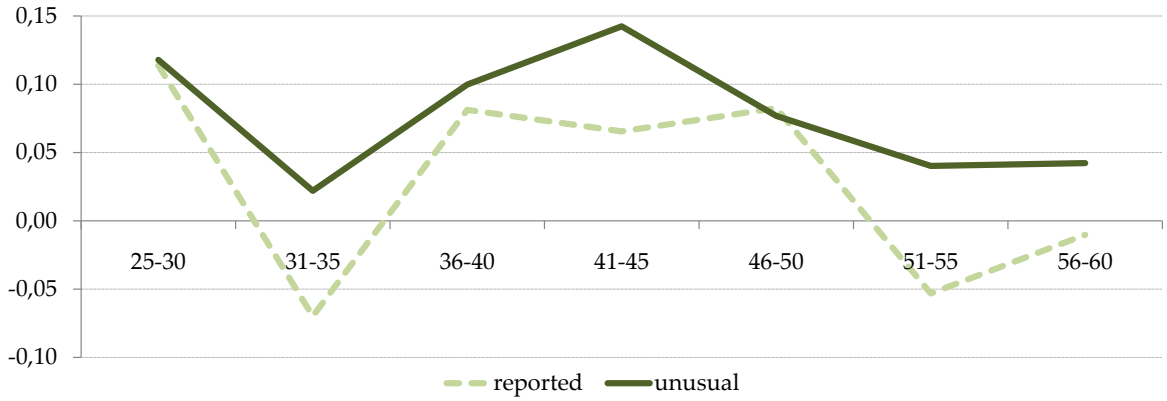
sleep is done to a similar extent between the groups of workers. Also in absolute terms, the coefficient estimates by decile of the sleep time distribution, are relatively low for the lower median. Since these lower values of the sleep time distribution can be interpreted as evidence for deprivation of sleep, men who work at unusual hours are not found to be exposed to augmented risks to mental health. For the upper half of the sleep distribution, higher fractions of solitary leisure are correlated with significantly more sleep of men who work at unusual hours. These findings are rather in line with the substitution hypothesis. Consequently, it can be argued that men who work at unusual hours are not exposed to higher risks of mental health mirrored by the impact on the minutes of sleep. Yet, since work at unusual hours, rather contributes to a widening of the working hours distribution but to a greater extent to work at the fringes of the standard workday, long-run consequences to health are expected to be minor. In addition, such working schedules have started to disseminate during the last decade so that long-run consequences are expected to arise with some delay.

In contrast, shift workers, tend to substitute more of their overall free time with sleep so that already for men in the lower parts of the sleep time distribution, higher fractions of solitary leisure are correlated with significantly more time devoted to sleep. Here again, the substitution hypothesis according to which shift workers are likely to sleep longer to not be alone might be a possible explanation. Another possible explanation could be that sleep is used therapeutically in order to cope with the higher burden associated with such jobs. These hypotheses cannot be disentangled here. Yet again, these estimates do not hint at augmented risks to mental health proxied by sleep deprivations.

To shed further light on further potential long-run risks due to the exposure to work at unusual schedules, I will now explore the interaction between sleep and age in more detail. Unfortunately, the dataset does not provide information about job tenure or the length of exposure to shift work or the rotating shift schedules. In order to explore potential long-run risks to health associated with shift work or work during unusual hours, I will use age as a proxy. In section 4.3, I have examined the association between shift work and aloneness ratios for men under or above the age of 45 from an investment point of view. I will be more precise in this section. I argue that age is not only positively correlated with job tenure and thus with the potential exposure to work at unusual schedules or to shift work but that people tend to be more likely to be adversely affected by work disamenities and hence by unusual working schedules with increasing age.

Figure 6 shows the coefficient estimates of the respective indicator variable for separate regressions by age group on the fraction of solitary leisure. It shows that the estimate is elevated across

Figure 6: Coefficient Estimates of the Indicator Variable on Solitary Leisure Fractions by Age Group.



the age distribution for all men who work during unusual hours but in particular for men aged between 41 – 45. With increasing age, the differences between the respective group and the reference group shrink. This is however not driven by differences in the incidence among these age groups as figure 3 suggests. One explanation could be that older workers have adapted their rhythm of life to their working schedules and have organized their activities around. Also, such men are likely to have stable networks of potential leisure companions who have some routine with the working rhythm which further facilitates social interaction and is likely to mitigate the differences between the groups of workers (Hamermesh 2005).

Since age is a good proxy for tenure in the case of men, it is also a good proxy for the exposure to such working conditions. According to the estimates shown in figure 6, no adverse long-run consequences with respect to solitary leisure are found for older shift workers. Among the sample shift working men above the age of 50, about 22 percent report to work the morning shift, 63 percent in rotating teams and 16 percent in other kinds of shifts. It can hence be argued that with longer job tenure, older workers have a higher propensity to work shifts with more desirable working hours which would be an alternative explanation for the insignificant differences on solitary leisure for older shift workers. In the case of men who work during unusual hours, however, differences in solitary leisure between the groups tend to shrink with age, yet remain at an augmented level of about 4 percentage points for men above 50. These differences are not accurately measure but are definitely non-negligible.

To examine the potential long-run risks of shift work or work at unusual hours, I will now analyze the influence between age being a proxy of job tenure and exposure on the one hand and sleep as indicator for potential health related risks on the other. Sleeping problems that might arise from jobs are likely to intensify with age by further increasing health related risks. The first line of table

Table 13: Coefficient Estimates of the Indicator Variable on the Minutes of Sleep.

	shift workers	**unusual hours**
all workers:		
	3.405	23.558*
	(0.88)	(4.00)
by age group:		
under 35	14.485	40.321*
	(1.19)	(2.62)
35 – 45	12.139*	29.926*
	(2.24)	(3.39)
above 45	-9.454	13.020
	(1.62)	(1.41)

Absolute t-statistics in parentheses. * indicate significance levels of 10 % or higher; standard errors are robust. Also included in the regressions: age group dummies, skill indicators, dummies for being married, having children and having kids under the age of 6 and between 6 – 17, Western Germany, a non-employed wife, the log normal working hours, log hourly wages and the month of the interview.

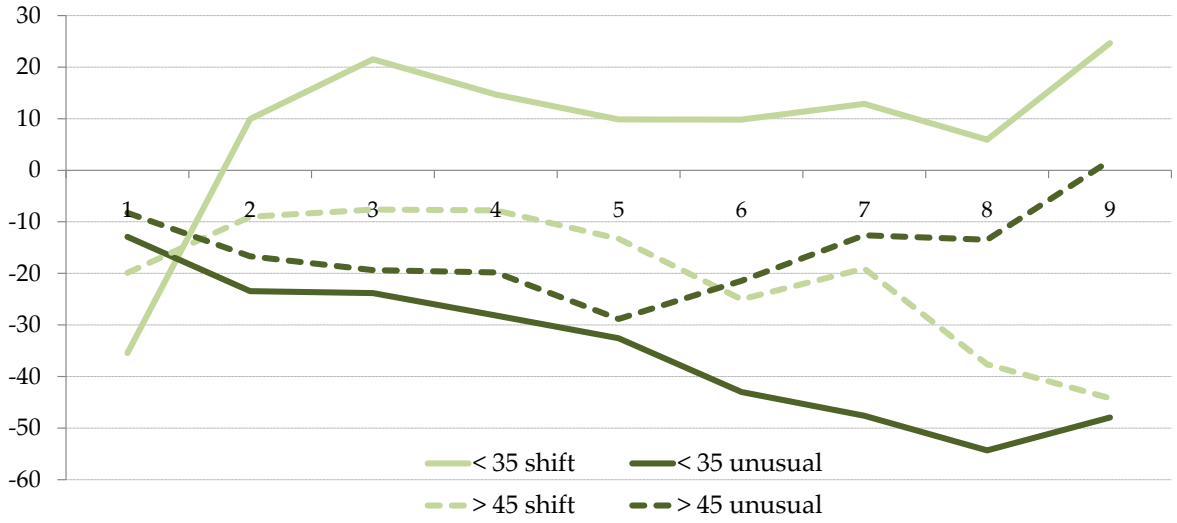
13 presents coefficient estimates for differences of shift work or work at unusual hours regarding the total minutes of sleep. Additional results by age group are further shown in the lower panel of the table. On average, people who work shifts but to a much stronger extent those men, who work during non-standard hours, tend to allocate more of their total available time to sleep. This estimate itself is not very informative as the consequences of the working schedules can affect the sleeping rhythm in opposite directions and both opposing influences cannot be disentangled.

To be able to find clearer evidence for potential forces that might be driving the amount of time allocated to sleep, table 13 additionally depicts estimates concerning the association between the indicator variable on total minutes of sleep by age group. These estimates suggest that shift workers under the age of 45 allocate slightly more time on average to sleep. Again, a possible explanation is that people with non-standard working schedules compensate their higher fractions of free time by more sleep. In this case, positive correlations are not directly evidence for an elevated risk to mental health. In contrast, shift workers above the age of 45 sleep on average less than the respective reference group. The coefficient estimate for the indicator variable is marginally in-

significant but can be interpreted as first suggestive evidence that older shift workers have a higher probability to be exposed to such jobs for a longer time span already which intensifies sleeping problems as compared to the respective reference group.

Men with unusual working schedules, in contrast, tend to devote more of their disposable time to sleep independent of age. However, with increasing age the differences between those men and the reference group grow smaller. Among the youngest age group, these men tend to sleep about 41 minutes more on average. Prime age men (35 – 45) tend to spend about half an hour more sleeping. As I have shown earlier, younger men who work with unusual schedules additionally spend significantly higher fractions of their total leisure alone. The combination of these findings can be interpreted as evidence in favor of the earlier hypothesis that these men tend to substitute their available free time with more sleep. If sleep substitution were not possible, it is possible that the fractions of solitary leisure would be even higher. In conclusion, these two results point into the same direction: men with unusual hours tend to have significantly lower levels of social interaction.

Figure 7: Sleep Differentials by Decile of the Sleep Time Distribution by Age Group.



To be able to find out whether shift work or work at unusual hours indeed elevates the risk to health, it is not sufficient to merely analyze the average impact on sleep but to also explore the extremes of the sleep time distribution. Figure 7 hence reports differences among the groups per decile of the sleep time distribution. The figure illustrates differences by age group relative to the estimates obtained for prime-aged men between 35 and 45. Negative values indicate that the sleep differential of the respective age group is lower than for prime age men. The absolute wage differentials by age group and decile are further shown in table 14 for a better understanding.

Table 14: Coefficient Estimates of the Indicator Variable on the Minutes of Sleep by Decile and Age Group.

	shift workers			**unusual hours**		
	< 35	35 – 45	> 45	< 35	35 – 45	> 45
1	-40.615	-5.154	-25.065*	-23.440*	-10.521	-18.792
2	-10.082	-20.000*	-29.014*	-25.994*	-2.545	-19.247*
3	0.981	-20.528*	-28.151*	-19.952*	3.870	-15.483
4	5.959	-8.735	-16.493*	-14.561*	13.594*	-6.215
5	10.795	0.922	-12.360*	-11.902*	20.672*	-8.154
6	22.139*	12.315	-12.716*	-12.988*	30.000*	8.554
7	32.885*	19.990*	0.917	-0.431*	47.190*	34.579*
8	47.332*	41.407*	3.754	8.821*	63.135*	49.656 *
9	90.276*	65.626*	21.432	13.712*	61.671*	63.510*
N	614	1260	1556	442	1260	1141

Absolute t-statistics in parentheses. * indicate significance levels of 10 % or higher; standard errors are robust. Also included in the regressions: age group dummies, skill indicators, dummies for being married, having children and having kids under the age of 6 and between 6 – 17, Western Germany, a non-employed wife, the log normal working hours, log hourly wages and the month of the interview.

It follows that across the sleep time distribution, younger shift workers tend to have on average higher sleep differentials than prime age shift workers whereas the opposite holds for shift workers above the age of 45. The table shows that with increasing age, the sleep differentials are lower and more negative for shift workers with lower average minutes of sleep. When only workers above 45 are regarded, shift workers up to the 6th decile tend to sleep significantly less than the reference group. This is interesting and suggests that such jobs are disruptive in particular with increasing age and harm the sleep routine. In addition, older men tend to be exposed to shift work for a longer time span which further elevates the potential risk to health.

In contrast, younger or older men who work during unusual hours tend to devote less time to sleep than prime-age men over the whole distribution of minutes of sleep which results in lower or oven more negative sleep differentials. Table 14 further shows that younger men with non-standard schedules tend to devote significantly less time to sleeping up to the 70 quantile of the distribution as compared to men with normal working hours and also as compared to the sleep differential obtained for prime age men. It shall additionally be mentioned here that levels of solitary leisure do not significantly differ for these men under the age of 35 compared to the refer-

ence group. This can be interpreted as indication that younger workers with non-standard working schedules substitute sleep with leisure which thus mitigates this strong adverse influence on solitary time at the expense of sleep. Such behavior cannot be interpreted as evidence for higher risks to mental health but might be more problematic with extended exposure. Men older than 45 also tend to devote less time to sleep than prime age men yet the differences are inaccurately estimated.

It can thus be concluded that younger workers are still able to master the stress associated with the working schedules by substituting sleep with leisure. Therefore, lower average levels of sleep are not indication enough for adverse long-run consequences on health. For older workers, in contrast, unusual working schedules and in particular shift work, tends disrupt the sleeping rhythm as lower average levels of sleep are observed across a large fraction of the sleep time distribution. Since sleep is one indicator for potential long-run risks and threats to mental health, these results can be interpreted as evidence in favor of augmented long-run consequences induced by the working schedules.

5 Conclusion and Discussion

In 2001, 15 percent of the European and the German workforce worked shifts. The relaxation of shop opening hours and of work time regulations in general imply that working hours at the margins of the work time distribution are inevitable in a more integrated world market. Such jobs are hence fundamental work patterns that shape the lifestyle of the population and will continue to do so to a growing extent.

This paper examines the consequences of a wider working hour distribution on social life to explore potential short and long-run risks arising from such working schedules. The higher hourly wage rates paid as compensation for the resulting disamenities further suggest that opportunity costs of leisure increase. Furthermore, lower levels of satisfaction with the allocation of work time further show that such jobs are not chosen because of preferences but rather because of monetary incentives as found in Scheffel (2011).

I find evidence that a wider working hour distribution is associated with higher average fractions of solitary leisure. Since people derive additional utility from spending time with others (Sullivan 1996, Jenkins and Osberg 2005), these findings imply lower marginal utility derived from leisure when social interaction becomes more difficult to arrange with others. The individual's well-being is hence likely to be adversely affected which in turn harms the individual's productivity.

Sleep and solitary leisure are positively correlated which suggests that people generally tend to substitute aloneness against sleep. In this respect, sleep is likely to have a therapeutic function. Yet, a longer exposure to aloneness on the one hand and adverse consequences of working schedules on the other is likely to augment the potential long-run risks to health. I find that in particular older shift workers tend to have the highest risks. Younger shift workers, in contrast, rather substitute sleep against leisure which mitigates the strong disruptive influence on solitary leisure. Moreover, I find evidences that younger shift workers with higher than median earnings and all men who work during unusual hours accept the higher level of solitary leisure from an investment perspective to benefit from the wage premia associated with such jobs.

Repercussions of non-standard working schedules on social life arising from decreasing marginal utility of leisure are largely ignored in the economic discussion so far. Although it seems economically sensible to extend the margins of the working hour distribution and the incidence of shift work to increase firm's output and consequently to accelerate aggregate economic growth, strong adverse effects on social life must not be ignored. Individual and consequently aggregate well-being is likely to be impaired which under certain conditions might even decelerate economic growth. The combination of a negative selection of workers and sizeable wage premia paid as compensation for the disamenities of such jobs on the one hand and the higher levels of aloneness and the adverse consequences on sleep are further evidence that already disadvantaged workers are disproportionately affected. In addition, Hamermesh (1999a) points out that the focus on merely pecuniary aspects strongly downward biases the changes in inequality of overall returns to work over the last decades in the US. The potential threat of marginalization of these workers must be taken seriously but requires additional in-depth analysis which is left to future research. Current German laws protect evening and night workers from the drastic adverse consequences of the working schedules. It is therefore important to not only compensate such workers by higher wage premia as men with lower labor market characteristics are disproportionately attracted. Other forms of compensations must be offered for example in the form of higher leisure time compensations to mitigate the strong adverse consequences on social life and the resulting long-run disruptions to health.

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6 Appendix

Table 15: Selection Corrected Coefficient Estimates of the Group Indicator on the Fraction of Solitary Leisure.

	indicator variable (1)	**selection term** (2)
shift work	0.053*	-0.007
	(3.25)	(0.50)
unusual hours	0.134*	-0.026
	(2.96)	(0.99)

Absolute t-statistics in parentheses. * indicate significance levels of 10 % or higher; standard errors are robust. Also included in the regressions: age group dummies, skill indicators, dummies for being married, having children and having kids under the age of 6 and between 6 – 17, Western Germany, a non-employed wife and the log normal working hours.

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